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(54) Title: ABSORBTION MATERIAL FOR FILTER ARRANGEMENT

(57) Abstract

Filters are used for collecting up the liquid particles when diverting exhaust gases containing liquid particles. The object of the invention is to use foam plastic in which the closed cells have been perforated, as absorbtion material.

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Absorbtion material for filter arrangement

The present invention relates to an absorbtion material for a filter arrangement. Suction means are generally used in premises where troublesome gases are formed, these means including a filter to collect constituents which shall not be released to the environment outside said premises. Filters to collect troublesome constituents in the gases are also arranged in front of the outlet openings of material emitting troublesome gases. Carbon particles has hitherto been used to provide such absorbtion material. It has been found in practice that such filters with carbon particles are not efficient enough to eliminate liquid particles from flowing gaseous media.

The object of the present invention is to efficiently take care of liquid particles in flowing gaseous media. This is achieved by using one or more bodies including closed spaces which have been perforated. The bodies may suitably consist of foam plastic in which the closed spaces have been perforated.

A filter may be formed by one or more parallel-epipedic blocks or it may consist of a casing containing a number of smaller bodies of different shape which have been compressed.

A filter can also be produced from a body shaped as a mat or strip which is rolled to suitable shape and placed in a casing.

The absorbtion material in the filter is suitably elastic. In such case the material in the filter can be subjected to compressed so that the constituent absorbed from the gaseous medium flowing through the filter can be recovered.

The absorbtion material in the filter suitably consists of polythene, polypropylene or a copolymer or polythene and metacrylic acid. Further characteristic features of the present invention are revealed in the following claims.

The absorbtion material according to the invention invention is preferably manufactured from a polythene granulate which is mixed with small quantities of powdered additives with the object of forming bubbles. The mixture is fed into the first stage of a two-stage extruder of screw type and is heated to ca. 200°C. The melt obtained is fed into the second extruder stage where the temperature is lowered to 100 - 150°C and is extruded through an annular nozzle. A porous tube is obtained and the tube is cooled internally and externally with air and then cut in longitudinal direction to form a strip of foam plastic. Parallel-epipedic bodies may of course be formed instead of strips.

If parallel-epipedic bodies are produced, they are suitably placed in the frame of a filter arrangement. If a mat is used, however, it must be rolled up, suitably shaped and inserted in a casing which is then placed in a filter arrangement.

According to the invention the mat or parallel-epipedic bodies may also be disintegrated into small particles. A casing is then filled with said small particles and placed in a filter arrangement.

A filter arrangement of the type described above functions in the following manner. Gas containing liquid drops is allowed to pass the filter arrangement, whereupon the liquid drops are caught by the absorbtion material and, if the gas contains constituents which are converted to liquid at a drop in temperature, the liquid formed in this way will also be absorbed. When the filter arrangement is saturated, the absorbtion material is removed and replaced by fresh material. The absorbtion material in the saturated filter is then subjected to compression whereupon the material absorbed can be recovered for re-use. After compressing the absorbtion material is once more usable. An absorbtion material has thus been produced which not only absorbs liquid particles, but also enables recovery of these particles so that the material is once more usable as a filter.

An endless strip can be produced from the mat of absorbtion material mentioned above. This strip is then allowed to run over two rollers,

one of which is driving. A strip arranged on rollers is placed in a filter arrangement so that a gas is allowed to flow through one part of the strip and then a second part of the strip. The strip will thus absorb liquid particles which can be recovered if an additional roller is arranged by one of the rollers, pressing against the strip. Each part of the strip will therefore be supplied with gas containing liquid particles on two different occasions and the liquid absorbed is then pressed out between the two cooperating rollers.

CLAIMS

1. Absorbtion material for a filter arrangement to be placed in the flow path of primarily gaseous media which may contain liquid particles or gas which is converted to liquid form at a drop in temperature, characterised in that said material consists of one or more bodies preferably elastic and including closed spaces which have been perforated.

2. Absorbtion material according to claim 1, characterised in that the material can be compressed so much that said closed, perforated spaces become completely or partially flattened or crumpled.

3. Absorbtion material according to claim 1, characterised in that it consists of foam plastic such as polythene, polypropylene and a copolymer or polythene and metacrylic acid.

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE83/00283

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

B 01 D 39/00

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
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US Cl	264:54

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US, A, 2 961 710 (NORMAN H STARK) 29 November 1960	1-3
A	DE, B, 2 927 287 (HELSA-WERKE HELMUT SANDLER & CO) 21 May 1981	1
A	GB, A, 1 567 645 (SCOTT PAPER COMPANY) 21 May 1980	1

* Special categories of cited documents: [15]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [6]	Date of Mailing of this International Search Report [9]
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****See application file for complete search history****

REF-CITED:

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ART-UNIT: 1732

PRIMARY-EXAMINER: Kuhns; Allan R.

ATTY-AGENT-FIRM: Nixon & Vanderhye, P.C.

ABSTRACT:

Disclosed is a method of producing a non-woven web of fibrous or particulate material comprising: formation of a foam slurry; deposition of that slurry onto a foraminous element having a three-dimensional mold; and formation of a web having a three-dimensional shape that is not substantially planar by removal of foam from the slurry through the foraminous element and drying the web. An apparatus therefor is also disclosed. The method may be used in production a variety of products, including automotive pleated fluid and air filters, pleated heating and/or air conditioning (HVAC) filters, shaped breathing mask filters and bacterial filters, laminated cleaning products with super**-absorbent** middle layers, such as a mop wipe shape to fit a cleaning mop head, and other products.

34 Claims, 8 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 4

Abstract Text - ABTX (1):

Disclosed is a method of producing a non-woven web of fibrous or particulate material comprising: formation of a foam slurry; deposition of that slurry onto a foraminous element having a three-dimensional mold; and formation of a web having a three-dimensional shape that is not substantially planar by removal of foam from the slurry through the foraminous element and drying the web. An apparatus therefor is also disclosed. The method may be used in production a variety of products, including automotive pleated fluid and air filters, pleated heating and/or air conditioning (HVAC) filters, shaped breathing mask filters and bacterial filters, laminated cleaning products with super**-absorbent** middle layers, such as a mop wipe shape to fit a cleaning mop head, and other products.

Brief Summary Text - BSTX (3):

Foam processes are normally used for making planar forms having a uniform thickness, i.e., two-dimensional shaped forms, during web formation. In accordance with the present invention, a three-dimensional shaped form is created by using a three-

dimensional mold during web formation from one or more foam layers. Using a three-dimensional mold, e.g., a wire mesh mold, a pleated or grooved filter product, for example, can be formed directly from a foam having fibers or particles which, when applied to the mold, form the product. A wide variety of products can be produced using the foam processes and three-dimensional molds disclosed herein. For example, three-dimensional molds and foam processes are useful to produce a wide variety of filter products, including automotive pleated fluid and air filters, pleated heating and/or air conditioning (HVAC) filters, shaped breathing mask filters and bacterial filters, laminated cleaning products with super **absorbent** middle layers, such as a mop wipe shaped to fit a cleaning mop head, and other products.

Brief Summary Text - BSTX (6):

One application of the invention relates to the production of pleated or grooved filter paper, particularly for automotive use. Filter paper started to be used in automobiles some 40-50 years ago, and today is standard equipment in every car with a combustion engine. The applications for filter papers today can be divided into the following grade categories: auto air, **oil,** heavy-duty air (HDA), fuel media, and cabin air. The auto air media/filter paper is designed to trap the particles entering the engine with the air. The HDA filter paper has the same function, but is designed for a more demanding environment with large amounts of dust in the air (e.g., earth moving machines, etc.). An **oil** media/filter paper is designed to take the particles out of the **oil** stream entering the engine. The fuel media/filter paper is designed to filter particles from gasoline or diesel fuel before it enters the engine. The cabin air media/filter paper is designed to trap the outside particles before they come into the cabin or compartment where the passengers are sitting. There are also other applications for such filter papers.

Brief Summary Text - BSTX (7):

Automotive filter papers have previously been produced according to wet-laid processes, which date back to the early part of the 1900s. In the wet-laid process, fibers are broken up under agitation in a pulper. The fibers are then pumped in a liquid slurry through deflakers and refiners to the paper machine. The deflakers and refiners disperse the fibers, and give them a better surface for generating bonding strength. The main components on the paper machine are the wet end and the dry end. Between the pulper and the wet end, various types of wet and dry strength enhancing chemicals are also added. The wet end comprises a headbox and dewatering elements. Typically the headbox has a flat fourdrinier, incline wire, or cylinder type foraminous element. The dewatering elements are designed to suck out **water** from the slurry to dewater it from roughly a 0.05% fiber consistency to a 25% fiber consistency on a moving wire (foraminous element). After the wet end, the media enters the dry end. The objective there is to dry the filter media from 25% to about a 98-99% fiber consistency.

Brief Summary Text - BSTX (8):

The filter media is now either impregnated "on-line" on the same paper machine, or rolled up and impregnated "off-line" on a separate impregnation machine. The objective of the impregnation process is to fully saturate the media with a resin or latex (thermosetting or thermoplastic), and thereby give the media its final mechanical strength as well as making it convertible into a filter. The impregnation process basically includes an impregnation unit followed by dryers. The impregnation unit can be a size-press, roll coater, curtain coater, or the like, and the dryers can be any conventional contact/non-contact types. When the media reaches about a 10-15% moisture content, the **oil** and HDA media types are grooved, giving them a continuous S-shape in the machine direction. Grooving the media type increases the overall filtration surface and helps keep the subsequently formed pleats separated when pleating the media and building the filter element.

Brief Summary Text - BSTX (11):

Forming products from a fiber or particle foam is advantageous over wet-laid processes. For example, filter paper has been manufactured using a **water**-laid process. In that process, fibers in a liquid suspension are introduced onto a grooved mold. The depth of the liquid slurry is relatively shallow. Soon after the introduction of the fiber suspension, the slurry surface sinks below the top portion of the lower mold, losing the hermetic seal permitting suction from beneath the mold to avoid removing **water** from the fibrous slurry. When the seal is lost, the suction acts primarily on the portion of the mold having no contact with the suspended fibers. Consequently, the fiber formation at the bottom of the mold is slow and not optimal. Additionally, there is a possibility that the top portions of the mold would collect a smaller number of fibers than the bottom portions, because the fibers in the liquid slurry tend to settle and concentrate at the bottom of the mold. In contrast, the foam processes disclosed herein involve one or more layers of foam that each form a relatively-deep layer of foam in a three-dimensional mold. Because of the depth of the foam, it is unlikely that the upper surface of the foam will sink below the peaks in the lower mold surfaces. In addition, an upper mold may be used to shape the upper surface of the foam so as to conform to the shape of the underlying lower mold, and thereby avoiding having the tops of a lower mold extend entirely through a foam layer.

Brief Summary Text - BSTX (15):

The present invention is a foam web manufacture process that uses molds to shape and dry the foam into three-dimensional products, such as three-dimensional filters. These products may be single layered formed from a single application of foam, or a laminate formed of several layers of different foams. In a simplistic description, foam comprises a slurry of air, **water,** surfactant, and fibers or particles. The type of fibers, particles, or

combination of fiber and particles will depend on the product to be produced. For example, the fibers in the foam may be short cut fibers, having an average length of 0.05 mm (millimeters) or less. The fibers or particles conform to a three-dimensional mold as the foam is deposited in the mold. As the foam is deposited on the mold, the **water** and air (which is in the foam as air bubbles having a wide variety of different diameters) are drained through the mold, extracted and reused. The fibers or particles from the foam are deposited on the mold to form the web product. The fibers or particles are dried on the mold and the completed three-dimensional product is removed from the mold. The web product may be formed from a combination of fibers and particles, or entirely of particles that are deposited from the foam.

Brief Summary Text - BSTX (16):

The introduction of the foam onto three-dimensional molds is performed in a careful manner, to prevent the problems experienced by the **water**-laid process. These problems can be prevented, in part, because the consistency of the foam is 1% to 10% (and can be 20% for foams with super**-absorbent**) fibers) and is higher than the typically 0.01% to 0.5% consistency of the slurry in the conventional **water**-laid process. As a consequence of the higher consistency, the use of the foam process permits formation of thicker products, such as thicker filter papers or thicker layers of paper in a single stage. If larger consistencies are used in liquid-laid processes, the fibers tend to aggregate and form flocs before web formation occurs. Floc formation decreases the quality of the final product because of the associated fluctuations in thickness and other properties of the filter paper, which in turn cause variations in filtering ability within the same product.

Brief Summary Text - BSTX (17):

Additionally, the foam requires much less liquid than the liquid-laid process, reducing the **water** consumption significantly. A reduction in the **water** consumption decreases the size of equipment needed for transporting liquid downstream of the mold. After the foam is drained from the mold, the foam can be substantially reused. Generally, only fibers and particles, and possibly a surfactant, are added to the reused foam before it is deposited in another mold.

Brief Summary Text - BSTX (18):

In one embodiment, after foam is introduced onto a bottom mold, a complementary top mold is placed on top. Preferably, the top mold is substantially the inverse of the bottom mold, such that the ridges of the top mold substantially fit in the grooves of the bottom mold. Similarly, the grooves of the top mold fit substantially around the ridges of the bottom mold. The top mold can be used to ensure that the top portions of the bottom mold are covered with foam and thus sealed. Ensuring that foam remains over the top portions of the bottom mold prevents the loss of the seal and the associated problems

with suction described above. Additionally, the top mold can be used to apply pressure on the foam, increasing the pressure on the top surface of the foam and assisting the removal of **foam from the filter** layer.

Brief Summary Text - BSTX (25):

There are multiple advantages to using the present invention, and the following is a non-exhaustive list of benefits. First, the process is relatively fast, and delicate or reactive substances, like active carbon, odor removing substances, salts, super**-absorbent** products, etc., may be used without substantial degradation or substantial loss of properties. Second, the process can be operated in either batch- or continuous-type machines, providing flexibility in equipment or plant design. Third, the process uses foam, which provides the ability to deposit multiple layers without mixing different layers. Fourth, the process obviates the need to groove or pleat the filter paper after formation. Since the paper is not subjected to bending after formation, the risk of breaking the filter layers is minimal. Fifth, the process is useful with any short fiber, e.g., fibers of 50 mm or less, such as synthetic fibers, mechanically-treated wood pulp or chemically-treated wood pulp.

Detailed Description Text - DETX (2):

FIG. 1 is a schematic depiction of a prior art process using foam to produce filter paper in an on-line manner. First, the web is formed using the foam-laid process as indicated in 10, in which a slurry of air, **water,** surfactant, and fibers are moved into contact with a moving foraminous conveyor element, and then foam is removed from the slurry through the element to form a non-woven web. The fibers are short cut fibers, having a length of 50 millimeters or less. The fibers may be formed of synthetic materials, of mechanical wood pulp, chemical wood pulp and other fibrous materials. Drying and other conventional steps are also practiced in processing the foam.

Detailed Description Text - DETX (3):

The rest of the steps in FIG. 1 are applicable to **water**-laid processes, impregnation with conventional resins or latexes to enhance the properties of the web taking place at 11, and conventional grooving being practiced as indicated at 12, when desired. The steps 10, 11, and 12 are typically practiced at the web production facility. The conventional pleat 13 and resin-curing 14 steps are practiced at a location where the actual filter paper will be made, and perhaps installed in conventional canisters. The same process as illustrated in FIG. 1 may be done in an off-line manner, wherein impregnation and grooving occurs at a facility apart from where foam-laid web formation occurs (not shown).